The Symmetry of Our Visual Apparatus as a Dual Organ

A Plea to Modify the Customary Notation of the Ocular Meridians

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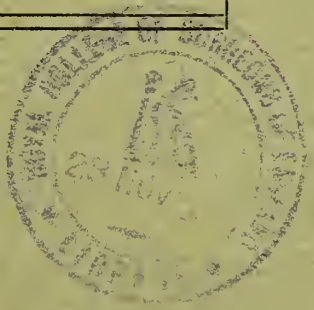
Reprinted from
THE JOURNAL
of the American Medical Association
September 13, 1902



THE SYMMETRY OF OUR VISUAL APPARATUS AS A DUAL ORGAN.

A PLEA TO MODIFY THE CUSTOMARY NOTATION OF THE OCULAR MERIDIANS.*

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Our visual apparatus is a dual (paired) organ, symmetrically placed on both sides of the median plane of the body. In the skull the dual parts coalesce at two places, the chiasm and the quadrigeminal bodies which are cut by the median plane, whereas in all other places the dual parts are so arranged that each of their points on one side has a corresponding point at equal distance on the other, as if one side were a reflex image of the other, cast by a plain mirror substituting the median plane of the body.

Outside the skull, all the remaining parts, orbits and their contents, as well as the eyeballs with all their intricate structures, follow the same rule; each point has its correspondent at the same distance on the other side of the median plane of the head.

My purpose, at this place, is to consider only one part of our visual organ with regard to the law of symmetry, the refractive apparatus. A complete analysis of the final refractive effect would require the determination of the curvature of the anterior surface of the cornea, the curvature and position of the surfaces, as well as the coefficient of refraction of the lens, and lastly, the inclination of the cornea and lens toward the optical axis of the eye, i. e., the centration of the refractive system.

It is well known that the anterior surface of the

* Read at the Fifty-third Annual Meeting of the American Medical Association, in the Section on Ophthalmology, and approved for publication by the Executive Committee: Drs. Frank Allport, H. V. Würdemann and J. A. Lippincott.

cornea has a greater influence on the refractive effect than all the rest of the system together.

The cornea—meaning its anterior surface—is not a part of a regular geometric body, but what mathematicians call a skew surface (*surface gauche, windschiefe Fläche*), in which the meridians differ from one another, causing a visual imperfection, the correction of which is one of the chief objects of the oculist's practice—astigmatism. The ingenious modification of Helmholtz's ophthalmometer by Javal and Schiœtz is accurate enough to determine the existence and degree of astigmatism as well as the direction of the principal meridians of the cornea, but falls short to determine the astigmatism of the whole eye, which not infrequently is influenced appreciably by the system of the crystalline lens. The determination of the astigmatism of the whole eye is satisfactorily done objectively with the ophthalmoscope by the direct method and the shadow test. The final test, however, always consists in the best correction of the vision with glasses. In this way the refractive condition can be determined with great accuracy. By these examinations, which every oculist has to make daily, it has come out that the principal meridians may be found in any position, yet with varying frequency.

The writer published in the Transactions of the American Ophthalmological Society* 1,000 cases of astigmatism with regard to the position of the meridians, and in the Transactions of the Ninth International Ophthalmological Congress at Utrecht† 1,473 cases more, the statistics of which were: 1, in 78 per cent. the meridians were symmetrically placed, in 22 per cent., asymmetrically; 2, the vertical meridian had the strongest curve in 56.5 per cent.; next in frequency came the horizontal, with 10.3 per cent.; 3, in the intermediary positions the strongest meridian inclined to the nasal side about twice as often as to the temple. Similar observations being in accord with these statements, and being well known, we need not go into further details.

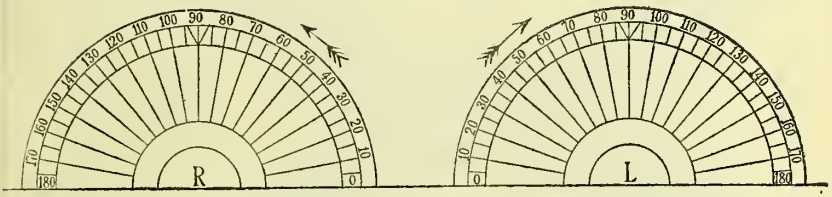
Now, which will be the best mode of recording the results of our examinations of astigmatic eyes? Snellen and other leading oculists use and recommend to take the vertical median plane of each eye as the basis from

* Meeting of 1892, vol. vi, p. 308.

† Page 65.

which to proceed, because it is parallel to the median plane of the body. Starting from the upper end of the vertical meridian, counting on both sides from zero down to the horizontal meridian, they call the degrees on the medial side plus, those on the lateral minus. I have used this system long, and proposed its adoption at the Seventh International Ophthalmological Congress at Heidelberg in the year 1888, and at the American Ophthalmological Society in 1892, only replacing the plus and minus signs by the indices n (nasal) and t (temporal), which Snellen (see preface to the last edition of his test-types, 1902) is willing to substitute for the plus and minus signs that require an explanation and readily lead to clerical errors.

At the Seventh International Ophthalmological Congress at Heidelberg in 1888 I recommended a second system of notation of the meridians and the field of



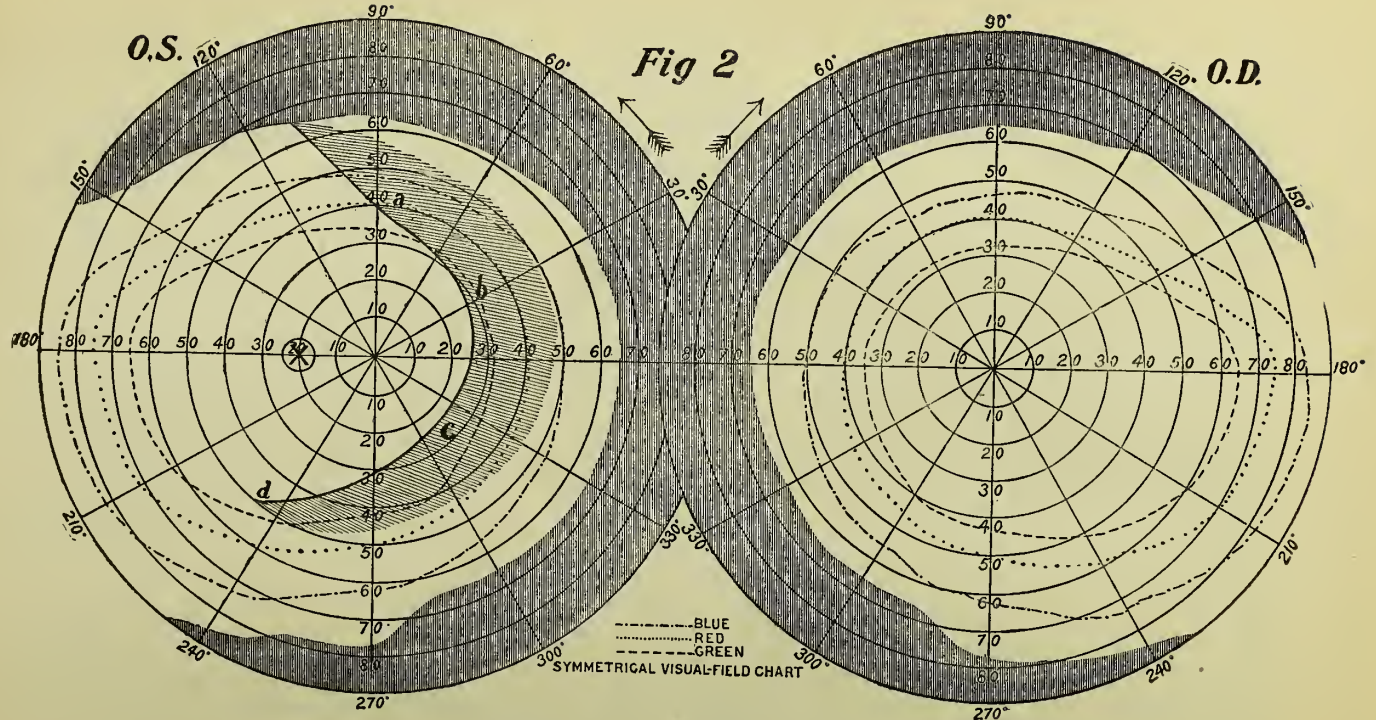
SYMMETRICAL ASTIGMATISM CHART.
PUBLISHED BY GALL & LEMBKE, NEW YORK.
Figure 1.

vision as equally suitable, namely, to begin at the nasal end of both horizontal meridians, mark them 0°, and count upward and all around the circle until we return to 360°, coinciding with the starting point 0°. I said:* "If this system should be chosen I would accept it with pleasure. It is expedient, perspicuous, plain and precise. Clerical mistakes between + or n and — or t would not occur."

At the last International Ophthalmological Congress† I brought up this subject again in one of the general sessions with a view to establish a uniform designation of the meridians of the eye and the field of vision as well. I no longer advocated the vertical meridian as the basis, but recommended the second system, which I

* See Bericht 7. Internat. ophthal. Congresses, p. 428, Wiesbaden, 1888.

† The Ninth, at Utrecht, 1899.



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O. S. Blind spot: me 180, pa 20. Glaucoma: a = me 90, pa 40; b = me 30, pa 29; c = me 325, pa 23; d = me 236, pa 50.

O. D. Green-field: me 0, pa 35; me 60, pa 32; me 120, pa 37; me 170, pa 60; me 180, pa 64; me 210, pa 60; me 242, pa 50; me 300, pa 40.

had declared as equally suitable at the Heidelberg congress, and which departs only slightly from the system most common in America, is in perfect harmony with the principle of symmetry, and our diagrams will read the same whether looked at from in front or from behind.

The American method has the disadvantage that it disregards the symmetry in the position of the meridians; for instance, of the temporal diagonal meridians the left is marked 45 degrees, the right 135. If we begin the count on the nasal end of each horizontal meridian both would be marked 135, as they should be, being identical.

In the system which I propose we have just as rational and convenient *a chart for the visual field* as for the meridians. The chart contains meridial and parallel circles all around. Any point, any defect of F., can be clearly designated by two numbers, that of the meridian and that of the degree of latitude, just as the mariner designates the position of his ship by the longitude and latitude on his charts. This can be put into the text of a written or printed report as well as the formulas for astigmatic spectacle glasses. Anyone that wants to map it out need only transfer to the chart the points of outline of the defect found by the examination. In our daily practice a cursory examination of the visual field is as indispensable as that of the acuteness of sight. Locating the blind spot gives us an angle of 20 degrees from the visual line as a basis for the diagram in our case book. Whenever a more accurate determination is important, the perimeter and the chart book are always at hand. The points in the upper half of the field of vision are designated by the crossing of points of the meridians from 0 to 180 and the respective parallels, the points in the lower half by the meridians from 180 to 360, i. e., 0 and the respective parallels; for instance, the blind spot X is located at me 180°, pa 20°. If we abridge meridian into *me,* and degree of latitude into *pa,* we can easily mark down the outlines of any line or figure in the visual field. See the notation at figure 2. In noting the crossing points the letters *me* and *pa* may also be omitted, it being understood that the first number of each pair of degrees always refers to the meridian, the second to the parallel; for instance, 190°, 30° = me 190°, pa 30°, means the crossing point of the 190th meridian with the 30th parallel.

As far as I have given this subject thought and action, the proposition which I made as my second choice at Heidelberg, as my first choice at Utrecht, and, in a more elaborate shape now make before you, gentlemen, is, to my mind, the best among the many that have been tried. It rests on a scientific basis, is of easy application and meets the requirements of our daily practice as well as—personally, I should say better than—any other. Will it have a sufficient advantage over the one that has been in use in America almost generally for so many years? I think it will. I hold myself partially responsible for the customary—call it the American—system. Shortly after I had made this country my home (in October, 1868) the late Dr. Henry D. Noyes of New York came to me with the question: "What manner of designating the meridians would you consider the best for us to adopt?" I told him the one which physicists generally use and Helmholtz has followed in the chapter on the movements of the eyes in his "Physiological Optics," viz.: "Start from your left side and proceed to your right as the hands of the clock." Dr. Noyes asked no more. I find he had described this system at the Fifth Annual Meeting of the American Ophthalmologic Society, July 21, 1868.[1] From that time the method began to spread in this country.

The American method is best adapted for problems of motility where the requirements of single vision demand harmony in our motions as if the two eyes were blended into one. The problem before us, however, is merely optical, its solution rests on immutable anatomic conditions in the investigation and appreciation of which the symmetrical position of the meridians is the controlling principle.

The change from the old system into the new would be simple. 1. It will require a new plate on the spectacle frame for the left eye, placing zero on the nasal and 180 degrees on the temporal side. 2. A diagram of the prescription with the same change for the optician marked: symmetrical notation, to distinguish it from the customary notation, which may be called homonymous. 3. Perimeter charts marked symmetrically, i. e., zero at the nasal end of both horizontal meridians. Counting the meridians from the inner canthus up, along the

1. See Transactions Am. Ophthalmological Society, vol. I, Fifth Annual Meeting, "Observations on Astigmatism," p. 29.

brow, temple and cheek to 360 degrees or zero at the inner canthus. When these changes are made there will be no confusion and we shall be accustomed to the new system in less than a week.